

Appendix D – Cash Flow Model

Introduction

The purpose of our analysis is to estimate the MMI Fund's economic value as of fiscal year end 2000 for all cash flows (incoming and outgoing) relating to both its current mortgage portfolio, and the effect of future books of business. We approached our evaluation of the Fund as though we were estimating its market value, in which case the economic value of the Fund equals the net present value of future cash flows from its current book of business, plus the value of current assets. Our evaluation of the Fund involves projecting the future performance of the Fund's loans and financials under different economic scenarios.

There are several differences between the cash flow models used for the fiscal year 2000 Actuarial Review and that used for the 1999 Actuarial Review.

- The 2000 Review is done on an endorsement year basis; the 1999 Review was done on an origination year basis. See the end of this section for a description of the results of our origination year analysis to an endorsement year basis.
- The 2000 Review incorporates a revised premium schedule based on Mortgagee Letter 00-38 with an effective date January 01, 2001¹.
- The 2000 Review incorporates the revised conditional claim rate and conditional prepayment rate models.
- The 2000 Review incorporates the revised demand and claim severity models.

See the attached exhibit, *MMIF Cash Flow Model – Schematic Diagram*, for an overview of the cash flow and its component parts.

In order to evaluate future performance of the Fund, we developed a model that projects the Fund's major cash flows using forecasts of:

- 1) Future claims and prepayments on in-force loans (see *Appendix A, Conditional Claim and Prepayment Rate Models*)
- 2) Number of mortgage originations for endorsement years 2001-2007 (see *Appendix B, Demand Model*)
- 3) Average loan size for endorsement years 2001-2007 (see *Appendix B, Demand Model*)
- 4) Future claims and prepayments on loans endorsed from 2001-2007 (see *Appendix A, Conditional Claim and Prepayment Rate Models*)
- 5) Loss rates on future claims for in-force and future loans (see *Appendix C, Claim Severity Model*)

¹ Mortgagee Letter 00-38 states that no additional annual premium will be collected once a loan achieves a loan-to-value (LTV) ratio of 78% (under all circumstances annual premiums are collected for a minimum of 5 years). This LTV ratio reflects only loan amortization and does not reflect the impact of house price appreciation. Further details are provided in Table D-2.

These projected cash flows are aggregated on a present value basis by fiscal year and endorsement year for 15-year and 30-year fixed rate mortgages (FRMs), adjustable rate mortgages (ARMs), and 15-year and 30-year Streamline Refinancings (SRs).

Cash flows are projected at the same loan type and loan-to-value level of detail used in the Conditional Claim Rate and Conditional Prepayment Rate regression analyses. It should be noted that the cash flow analysis does not go beyond this level of detail. For example, geographical location (census division, MSA) is not explicitly considered in the forecast.

Cash Flows

Components of the cash flow model can be grouped as either income (money paid into the Fund) or as outgo (money paid out of the Fund) in the following way:

Table D.1

Income	Outgo
Premium	Refunded upfront premium
- upfront	Payments on claims
- annual	Administrative expenses
Interest income on invested assets	Distributive shares (if declared)

Premiums

The insurance premium is the primary source of revenue collected by the Fund. Upfront premium is based on the specified premium rate applied to the original mortgage amount less financed premium. The mortgage amounts used in these calculations are from the Single Family Data Warehouse and are inclusive of any financed upfront premium. However, the database does not provide information on which mortgages have financed upfront premiums. In our model, we assume that upfront premiums are always financed (based on the assumption that by financing the upfront premium, a borrower would have more cash to apply to their down payment and lower the mortgage amount excluding premium, thus reducing annual premiums).

Annual premium is calculated by applying the appropriate annual insurance premium rate to the amortized insurance in-force (scheduled unpaid balance on surviving loans) less financed premium, each year for the specified number of years. Since the annual premium rate is not applied to the financed upfront premium, we exclude financed upfront premiums when calculating the loan balance which is the basis for the annual premium.

During the period of time being analyzed, the insurance premium was structured as follows:

Table D.2

	30-yr Loans, Fixed or Adjustable		15-yr Loans, Fixed or Adjustable		30-yr Loans, Streamline Refinancing		15-yr Loans, Streamline Refinancing	
	Up-front Premium	Annual Premium	Up-front Premium	Annual Premium	Up-front Premium	Annual Premium	Up-front Premium	Annual Premium
prior to 9/1/83	None	0.5% for life of loan	None	0.5% for life of loan	N/A	N/A	N/A	N/A
9/1/83-6/30/91	3.80%	None	2.40%	None	3.80%	None	2.40%	None
7/1/91-9/30/92	3.80%	varies by LTV category*	2.00%	varies by LTV category*	3.80%	0.5% for first 7 years	3.80%	0.5% for first 7 years
10/1/92-9/30/93	3.00%	varies by LTV category**	2.00%	varies by LTV category***	3.00%	0.5% for first 7 years	2.00%	None
10/1/93-4/16/94	3.00%	varies by LTV category**	2.00%	varies by LTV category***	3.00%	0.5% for first 7 years	2.00%	None
4/17/94-9/30/94	2.25%	varies by LTV category**	2.00%	varies by LTV category***	2.25%	0.5% for first 7 years	2.00%	None
10/1/94-9/30/96	2.25%	varies by LTV category**	2.00%	varies by LTV category***	2.25%	0.5% for first 7 years	2.00%	None
10/1/96-9/30/97	2.25%, except counseled first-time buyers	varies by LTV category**	2.00%	varies by LTV category***	2.25%	0.5% for first 7 years	2.00%	None
10/1/97-12/31/00	2.25%, except counseled first-time buyers	varies by LTV category**	2.00%	varies by LTV category***	2.25%	0.5% for first 7 years	2.00%	None
1/1/01 and subsequent	1.50%	0.5% until LTV reaches 78%, minimum of 5 years	1.50%	varies by LTV category****	1.50%	0.5% until LTV reaches 78%, minimum of 5 years	1.50%	varies by LTV category****

LTV Range:	*	**	***	****
LTV<90%	0.5% for 5 years	0.5% for 7 years	0%	0%
90%<LTV<95%	0.5% for 8 years	0.5% for 12 years	0.25% for 4 years	0.25% until LTV reaches 78%
95%<LTV	0.5% for 10 years	0.5% for 30 years	0.25% for 8 years	0.25% until LTV reaches 78%

Losses Associated with Claims

The estimate of cash outgo due to payments on claims is calculated based on the projected conditional claim rate (see *Appendix A*), the projected loss rate (see *Appendix C*), and the amortized insurance in-force. We estimate amortized insurance in-force based on projections of

the number of surviving loans (which depend on projected claim rates and prepayment rates), average loan size, and a schedule of amortization factors. The amortization factors estimate the unpaid balance on the loans in a given cohort based on the age of the cohort and on the average (initial) interest rate on the loans in the cohort. The schedule is adjusted for adjustable rate loans to reflect projected changes in the 52-week Treasury bill yield, as the available ARM interest rate is assumed to be equal to a constant 250 basis points above the 52 week T-bill yield (see *Appendix F, Economic Forecast*).

The present value calculation is complicated by the fact that the loss rate reflects the net impact of outgo (claim payment and maintenance expenses on conveyed property) and income (proceeds from sale of property). We assume that the termination, and therefore the claim payment, occurs at the midpoint of the fiscal year. We further assume that the disposition of the property takes place three months subsequent to termination of the loan.

Refunded Premiums

Beginning in FY 1984, the FHA began refunding a portion of the upfront premium when borrowers prepay their mortgages. Upfront premiums are assumed to be earned over the life of the loan, so that when a mortgage is prepaid, a calculated portion of the premium is left unearned and is returned to the borrower. The refunded amount depends on the age of the mortgage when it is prepaid.

Table D.3 provides the refund schedule showing the percentage of upfront premium refunded at different points in time after loan origination.

Table D.3

Years since Origination	Termination Date			
	9/1/83-12/31/93		1/1/94-12/31/00*	1/1/01 and subsequent**
	30-yr Loans	15-yr Loans	All Loans	All Loans
1	99%	99%	95%	85%
2	94%	93%	85%	65%
3	82%	81%	70%	45%
4	67%	66%	49%	25%
5	54%	51%	30%	10%
6	43%	39%	15%	0%
7	35%	29%	4%	
8	29%	21%	0%	
9	24%	15%		
10	21%	11%		
11	18%	8%		
12	16%	6%		
13	15%	4%		
14	13%	3%		
15	12%	2%		
16	11%			
17	10%			
18	9%			
19	9%			
20	8%			
21	7%			
22	7%			
23	6%			
24	5%			
25	5%			
26	4%			
27	4%			
28	4%			
29	4%			
30	0%			

*Based on Mortgagee Letter 94-1 which provides a monthly schedule of refund rates. This table reflects the rate indicated for the midpoint of the 12-month interval, i.e., 6 mos., 18 mos., etc.

**Based on Mortgagee Letter 00-38.

Administrative Expenses

The cash flow model incorporates a projection of administrative costs associated with insuring mortgages. Administrative expenses, based on recent experience rates and projected growth and expense levels, are projected to be of 0.100 percent of the outstanding balance of amortized insurance in-force at the beginning of the period.

Distributive Shares

Because the MMI Fund is a mutual insurance fund, the FHA Commissioner has the authority to declare dividends or distributions. So, for example, the Commissioner could decide to use some of the money in the Fund to return a portion of the premiums to certain insureds when they terminate their loans. This was in fact done up until 1990. Since then, the payment of distributive shares has been suspended.

Economic Value and Capital Ratio

The capital ratio for FY 2000 is defined as the estimated economic value of the MMI Fund as of September 30, 2000, divided by the estimated unamortized insurance in-force of the Fund. The Fund's economic value is defined as the present value of future cash flows for all previous books of business plus capital resources of the Fund. For future fiscal years, the economic value is calculated as follows:

$$\text{Economic Value at Year-End} = \text{Economic Value at the Beginning of the Year} + \text{Economic Value of New Book of Business} + \text{Interest Income} - \text{Administrative Expenses}$$

The equation uses an annual interest rate of six percent, applied to all cash flows. This figure was selected based on discussions with Dr. L. Richard Keyser who oversees investments for FHA. We believe this rate is reasonable and consistent with FHA's current portfolio structure.

Cash Flow Model Dependencies

The following table shows the basis for each item of projected cash flow:

Table D.4

	Cash Flow Item	Source of Forecast
LOANS IN-FORCE AS OF 9/30/2000	Future Annual Premiums	1) Annual Premium Schedule 2) Projected Amortized Loan Balance*
	Future Premium Refunds	1) Refund Schedule 2) Up-Front Premium Schedule 3) Prepayment Rate Forecast 4) Projected Unamortized Loan Balance**
	Future Losses	1) Claim Rate Forecast 2) Projected Amortized Loan Balance* 3) Loss Rate
LOANS ENDORSED 2001-2007	Future Upfront Premiums	1) UFMIP Schedule 2) Projected 2001-2007 Endorsements
	Future Annual Premiums	see above
	Future Premium Refunds	see above
	Future Losses	see above
	Future Interest Income	Average Invested Assets During Fiscal Year
	Future Admin Expenses	Amortized Insurance Inforce at beginning of Fiscal Year

* Amortized Loan Balance (t) = Unamortized Loan Balance (t) * Amortization Factor (t)

** Unamortized Loan Balance (t) = Unamortized Loan Balance (t-1) * [1 - Conditional Claim Rate (t) - Conditional Prepayment Rate (t)]

Combination of LTV Category Projections to Loan Type Level

The conditional claim and prepayment models for fixed rate, 15-year and 30-year loans vary by LTV category. In order to estimate the implied conditional rates at the overall loan type level, we project claim and prepayment counts at the LTV level. We then sum these counts across LTV category to a loan type level. The conditional claim (or prepayment) rate for the loan type at a particular policy year is the total number of claims (or prepayments) projected for the policy year, divided by the total number of loans surviving at the beginning of the policy year.

Conversion to Endorsement Year Basis

All of our analysis was performed on the basis of fiscal origination year. That is, we grouped the loans into pools of loans that began amortizing in the same fiscal year. We converted conditional claim and prepayment rates to an endorsement year basis by assuming a three-month lag between origination and endorsement. We prorated the origination year rates by giving 75% weight to the current policy year and 25% weight to the subsequent policy year. For example, the conditional claim rate for endorsement year 2001 during policy year three is ${}_E r_3 = 0.75 \cdot {}_O r_3 + 0.25 \cdot {}_O r_4$ where ${}_O r_i$ is the conditional claim rate for policy year i of origination year 2001.

In order to estimate endorsement year conditional claim and prepayment rates at the LTV category level, we also had to make some assumptions about the distribution of endorsement year loans to LTV category. (We could not split the endorsement year directly to LTV category because we could not calculate LTV ratios for every record in the endorsement year data base. See Appendix E for a complete explanation.) We simply assumed that the endorsement year loans could be split to LTV category level in proportion to the split by LTV category in the origination year data base.

Combination of Loan Type Projections

The estimation of conditional claim and prepayment rates for all loan types combined is calculated in a way similar to the calculation of loan type level rates for the types that are modeled on a lower level of detail. We project claims, prepayments, and surviving loan counts by loan type and sum those values across loan type for on an origination year basis and on an endorsement year basis. We can then calculate the implied conditional claim and prepayment rates from the projected claim, prepayment, and surviving loan counts.

MMIF Cash Flow Model – Schematic Diagram

